

Method for Achieving Low Defect Density AlGa_N Single Crystal Boules

ABSTRACT OF THE DISCLOSURE

A method for growing bulk Ga_N and AlGa_N single crystal boules, preferably using a modified HVPE process, is provided. The single crystal boules typically have a volume in excess of 4 cubic centimeters with a minimum dimension of approximately 1 centimeter. If desired, the bulk material can be doped during growth to achieve n-, i-, or p-type conductivity. In order to have growth cycles of sufficient duration, preferably an extended Ga source is used in which a portion of the Ga source is maintained at a relatively high temperature while most of the Ga source is maintained at a temperature close to, and just above, the melting temperature of Ga. To grow large boules of AlGa_N, preferably multiple Al sources are used, the Al sources being sequentially activated to avoid Al source depletion and excessive degradation. In order to achieve high growth rates, preferably a dual growth zone reactor is used in which a first, high temperature zone is used for crystal nucleation and a second, low temperature zone is used for rapid crystal growth. Although the process can be used to grow crystals in which the as-grown material and the seed crystal are of different composition, preferably the two crystalline structures have the same composition, thus yielding improved crystal quality.